

**UNIFIED DISPOSAL DISTRICT LANDFILL
LICENSE NUMBER 389**

**ADDITIONAL HYDROGEOLOGICAL &
SOILS ANALYSIS**

OCTOBER 1993

**IS LOCATED ON THE
'OVER-SIZED' SHELF**

PREPARED BY: DAMSCHEN CONSULTING INC

RECEIVED: OCTOBER 21, 1993



DAMSCHE & ASSOCIATES, INC.
CONSULTING ENGINEERS

2030 11TH AVENUE • SUITE 11
P.O. BOX 4817 • HELENA, MT 59604

TELEPHONE (406) 449-8627
FAX (406) 449-8631

October 15, 1993

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OCT 21 1993

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

Mr. Edward Thamke
Montana Solid and Hazardous Waste Bureau
Cogswell Building
Helena, Montana 59620

Dear Mr. Thamke:

We are pleased to submit two copies of the most recent hydrogeological analysis of the Unified Disposal District landfill east of Havre, Montana. Included within the report is a brief summary of the hydrological and engineering work performed to date, a response to the review of the initial hydrogeological and soils report, a re-evaluation of the hydrogeological characterization of the site, and an evaluation of the ground-water quality.

We hope the information included within the document satisfies the requirements of the Bureau. However, if you have any questions or require additional information, please do not hesitate to contact us.

Sincerely,

DAMSCHE & ASSOCIATES, INC.

Bruce L. Siegmund
Project Hydrogeologist



DAMSCHEN & ASSOCIATES, INC.
CONSULTING ENGINEERS

2030 11TH AVENUE • SUITE 11
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July 20, 1993

Ms. Pat Potts
Montana Solid and Hazardous Waste Bureau
Cogswell Building
Helena, MT 59620

Dear Ms. Potts:

Enclosed please find two copies of the Sampling and Analysis Plan for the Unified Disposal District municipal waste landfill east of Havre, Montana. If you have any questions or require any additional information please do not hesitate to contact us.

Sincerely,

DAMSCHEN & ASSOCIATES, INC.

Bruce L. Siegmund
Project Hydrogeologist

Enclosures: 2

RECEIVED

JUL 20 1993

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
BUREAU





DAMSCHEN & ASSOCIATES, INC.

CONSULTING ENGINEERS

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June 9, 1993

RECEIVED

JUN 11 1993

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

Mr. Jim Wilbur
Montana Solid and Hazardous Waste Bureau
Cogswell Building
Helena, Montana 59620

Dear Mr. Wilbur:

We ask that the Bureau consider granting a 45 day extension for completion of the ground water monitoring network and sampling and analysis plan for the Unified Disposal District at Havre, Montana. Due to weather and site conditions, drilling could not be completed until mid-April of this year. Samples of the drill cuttings have been submitted to an analytical laboratory, however, we have been informed that the turnaround time is such that the results will probably not be returned for another two weeks. In short, with the exception of performing slug tests on some of the wells, the field work has been completed. We anticipate the evaluation of data and reporting to require an additional three to five weeks.

Thank you for your consideration. If you have any questions or require any additional information, please do not hesitate to contact us.

Sincerely,

DAMSCHEN & ASSOCIATES, INC.

Bruce L. Siegmund
Project Hydrogeologist



DAMSCHEN & ASSOCIATES, INC.

CONSULTING ENGINEERS

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OCT 14 1992

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

October 9, 1992

Pat Potts
Montana Department of Health and Environmental Sciences
Solid and Hazardous Waste Bureau
836 Front Street
Helena, MT 59620

Dear Pat:

The following is the Work Plan for conducting the Hydrogeological and Soils Investigation at the existing Unified Disposal District Landfill in Havre, Montana. The outline contained herein has been assembled from data included in previous reports and our own recent field investigations, as well as from your suggestions in our meeting of July 30, 1992. As agreed in that meeting, the results of the study proposed below will accommodate the requisite investigations for the District's Phase II and Phase III waste fill plan.

INTRODUCTION

Location and Description of Landfill Site

The landfill site is located approximately 11 miles southeast of Havre, Montana, in Section 1 of Township 32 North, Range 17 East and Section 6 of Township 32 North, Range 18 East (Plate 1). The waste fill area currently occupies the head of a small gulch (Plate 2). The fill area shown in Plate 2 was mapped in 1989, but the areal extent of the fill has changed very little since then.

Previous Work

Damschen & Associates, Inc. submitted a report to the Bureau entitled "Hydrogeological Analysis of the Existing Sanitary Landfill" in October of 1991. The proposed investigation is based on the results and conclusions drawn in that report.

PURPOSE AND SCOPE OF WORK

The purpose of the investigation is to provide the Bureau with adequate information to fully characterize the hydrogeological conditions and determine the properties of the naturally-occurring soils. In addition, the final Hydrogeological and Soils Investigation will provide the basis for the Ground Water Monitoring Plan and the Sampling and Analysis Plan required by the Bureau.

HYDROGEOLOGIC AND SOILS INVESTIGATION

The objectives of the investigation include:

- Identification of the uppermost aquifer or the uppermost water-bearing zone capable of transporting leachate laterally or vertically;
- Determination of the presence or absence of leachate proximal to the active landfilling area;
- Further characterization of the soils and substrate in the Phase II and Phase III fill areas;
- Formulation of a Ground Water Monitoring Plan and a Sampling and Analysis Plan for both the existing and future fill areas;
- Installation of a ground water monitoring network.

In order to achieve these objectives, we propose that a multi-phase approach be taken.

Phase I: Field Investigations

In order to comply with the current regulations, the 50-acre Unified District Landfill site requires 38 boreholes, nine of which must be drilled test borings. Because there has been extensive work performed at the site, it was agreed at the July 30, 1992 meeting that 20 test pits and 7 test borings would be sufficient to complete the investigation.

Test Pits. We propose that the requirement for 20 test pits be reduced to 15, because earth removal has been fairly extensive at the site and very good exposures up to 15 feet deep are available along the south side of the active fill area. In addition, the northwestern portion of the proposed fill area, where dirt is

currently being excavated for daily cover, is also well exposed, precluding necessity for further excavations. The proposed locations of the test pits are delineated on Figure 2.

Test Borings. Three test borings have been drilled proximal to the waste area (Plate 2; Havre Landfill Analysis and Design plan set, Sheet 2, Landfill Location Plan, Damschen & Associates, Inc., 1989). These borings revealed the presence of very small amounts of ground water at various elevations, however Test Boring #2 encountered shallow sand and gravel containing ground water that may have seeped around the collar to depth. The presence of shallow ground water in all of the known test borings raises the possibility that any leachate produced would be intercepted prior to reaching the deep, regional aquifer.

Three additional test borings need to be drilled in the vicinity of the existing waste pit in order to ascertain the depth to shallow ground-water and the quality of that water. This can be accomplished by drilling test borings around the fill area (TB-4, -5, and -6, Figure 2) to the first saturated zone encountered beneath the bottom of the landfill. If ground water is encountered in all of the test borings, the gradient can be established and the appropriate location for the installation of a ground water monitoring well can be designated. It is proposed that the well(s) be constructed at the time of the Phase I investigation.

Four more test borings will be drilled in order to determine the depth to and gradient of any shallow ground water further north of the existing waste fill area (TB-7 through TB-10, Figure 2). These borings will be drilled to the uppermost saturated zone and an attempt will be made to correlate the units and define the attitude of the hydraulic gradient while in the field. If this can be done to the satisfaction of our personnel and the Bureau's hydrogeologist, we would like to install the wells at the time of the Phase I field work.

It must be stated that an investigation of this type is of a dynamic nature. Discoveries in one borehole may impact the proposed locations and depths of other boreholes, so some latitude will be required as the project proceeds. If, for example, continuous shallow ground water is not encountered, deeper holes will be drilled to intercept the regional aquifer. These holes would be located in the same vicinity as those noted on Figure 2, at proposed test borings TB-8 and TB-10.

In addition, the stratigraphy of the area is fairly complex and will require surface mapping prior to drilling. Several matters of concern raised by the Bureau during the July 30, 1992 meeting

Pat Potts
Page 4
October 9, 1992

will be addressed by the mapping, such as the general attitude of the bedding, continuity of the stratigraphy, the presence or absence of structural elements.

The final Hydrogeological and Soils Report will address all of the appropriate elements, as outlined in ARM 16.14.703. This includes cross sections, hydraulic conductivity of saturated and unsaturated zones, and hydraulic gradients.

Phase II: Ground Water Monitoring Network

If the hydrogeology is sufficiently characterized, it would be most cost-effective to install the appropriate ground water monitoring wells during the Phase I field work. This alleviates the cost of a second mobilization of the drill rig and our personnel.

The monitoring network will include one background well and, assuming that the same saturated zone is monitored throughout the entire 50-acre site, four down-gradient wells. Two of the down-gradient wells will monitor water quality at or near a point of standards application. Two additional down-gradient wells will be dedicated to monitoring ground water that may be immediately impacted by the presence of waste in the active fill area. If the situation exists that two distinct saturated zones occur and if it is clear that different zones must be monitored, then one up-gradient well and two down-gradient wells will be constructed for each of the two areas under consideration. The locations of the finished wells will have to be determined after the test borings are completed. We will attempt to construct the monitoring wells in the test borings as soon as possible after static water levels have equilibrated as possible, assuming that the borings have maintained their integrity.

Phase III: Reporting

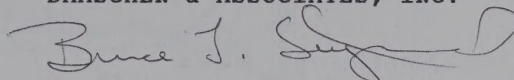
The final Hydrogeological and Soils Investigation will be submitted to the Bureau along with the Ground Water Monitoring Plan and the Sampling and Analysis Plan. We request that the previous reports issued by our Firm be regarded as submissions of data for the Hydrogeological and Soils Investigation, strictly to reduce redundancy. Any data from previous reports that are pertinent to the Investigation will be summarized, tabulated and included in the forthcoming document.

Pat Potts
Page 5
October 9, 1992

We hope this satisfies the Bureau's requirements, as set forth at our July 30, 1992 meeting. If you have any questions please do not hesitate to call.

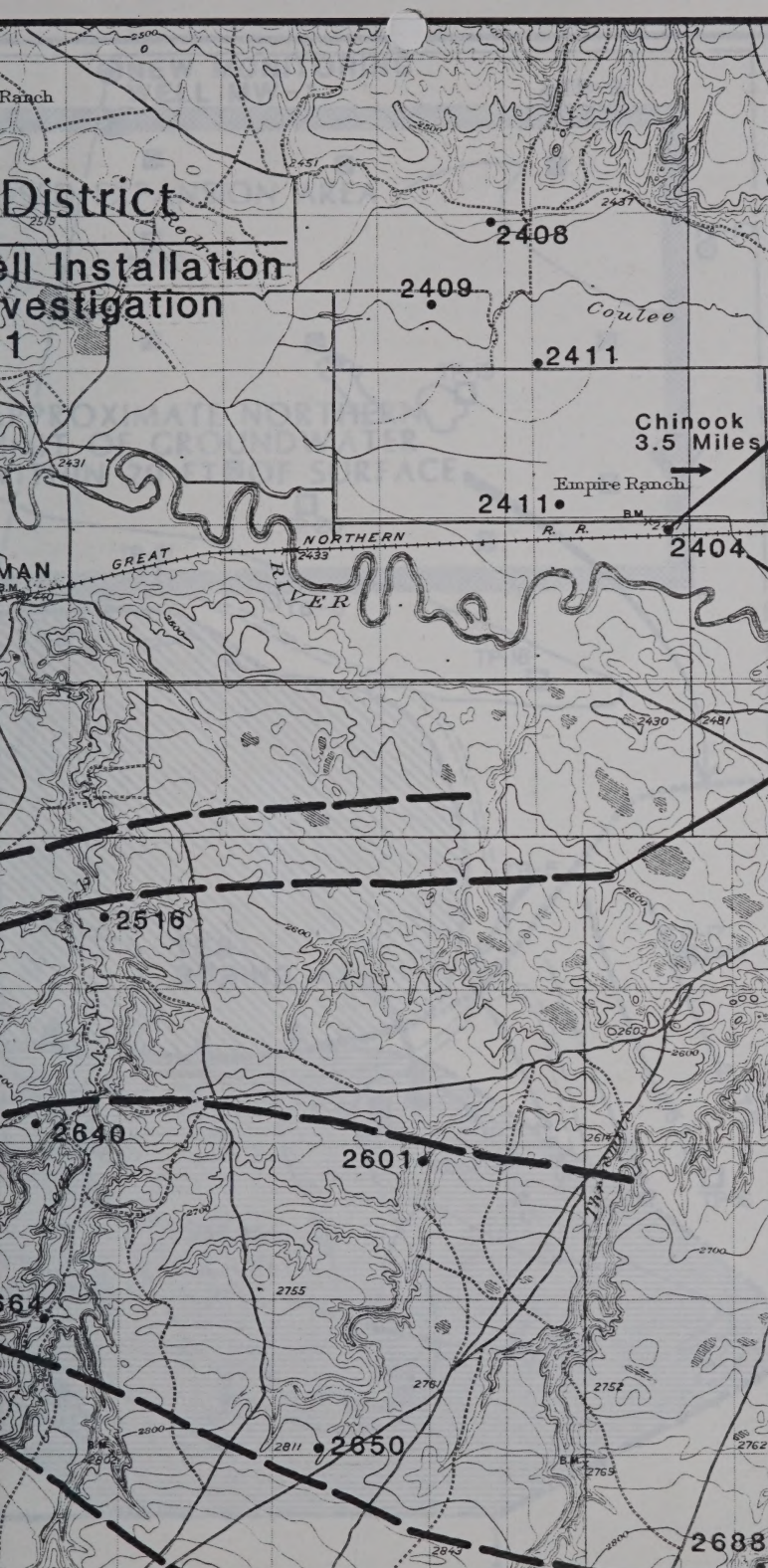
Sincerely,

DAMSCHE & ASSOCIATES, INC.

A handwritten signature in dark ink, appearing to read "Bruce L. Siegmund". The signature is fluid and cursive, with a large, sweeping loop at the end.

Bruce L. Siegmund
Project Hydrogeologist

BLS/jmr
Enclosures
cc: Larry Broere - Unified Disposal District



Scale: 1" = 1 mile

LEGEND

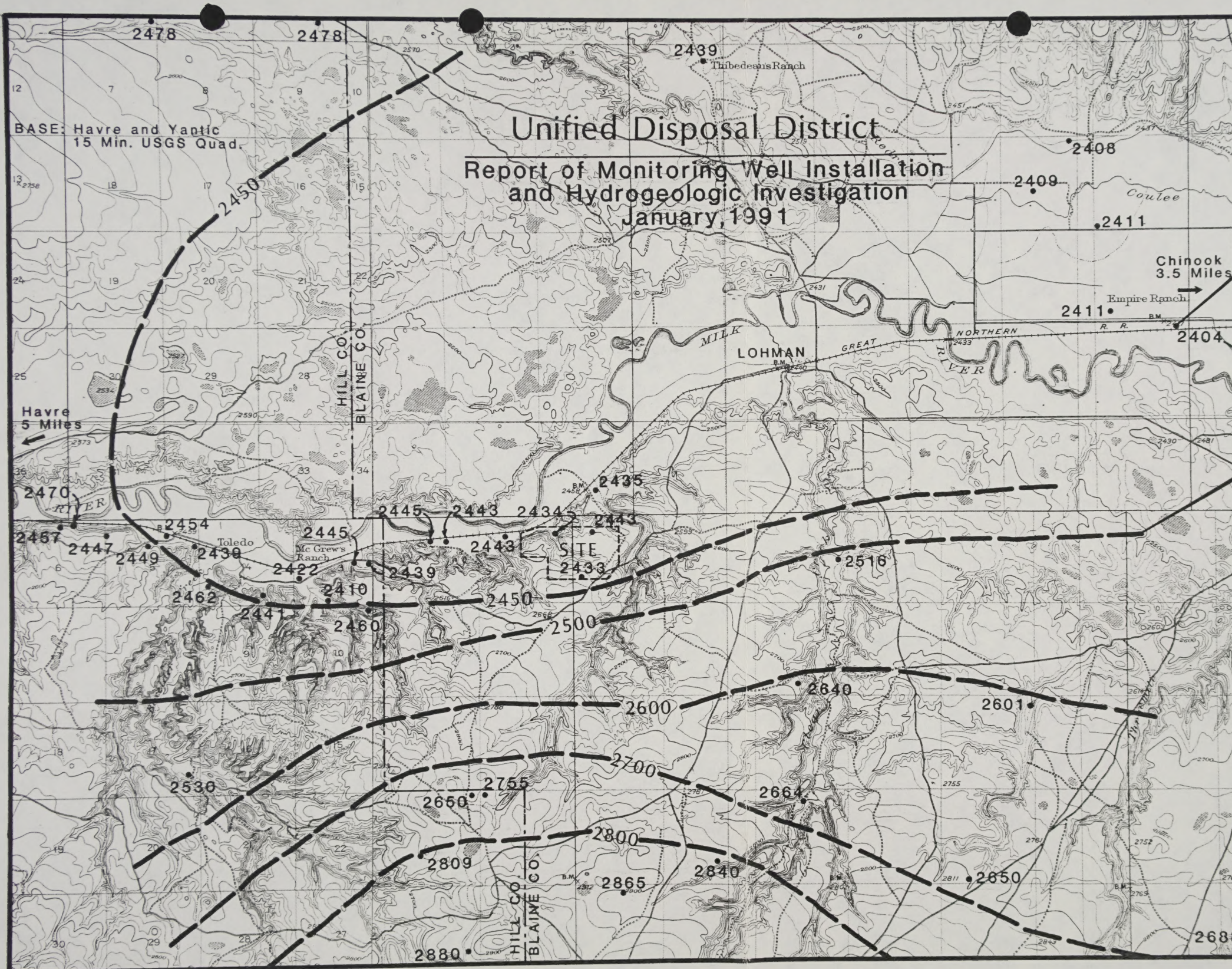
APPROXIMATE
LOCATION OF WELL
COMPLETED IN JUDITH
RIVER AQUIFER (TYP.)

ESTIMATED STATIC
WATER ELEVATION
IN WELL (TYP.)

CONTOUR OF EQUAL
POTENTIOMETRIC
ELEVATION IN JUDITH
RIVER AQUIFER (TYP.)

SOURCE OF DATA:
This study; Montana
Bureau of Mines and
Geology well log data
base; Levings 1981

PLATE 1: VICINITY HYDROGEOLOGIC MAP OF THE JUDITH RIVER AQUIFER



Scale: 1"=1 mile

LEGEND

APPROXIMATE
LOCATION OF WELL
COMPLETED IN JUDITH
RIVER AQUIFER (TYP.)

ESTIMATED STATIC
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PLATE 1: VICINITY HYDROGEOLOGIC MAP OF THE JUDITH RIVER AQUIFER

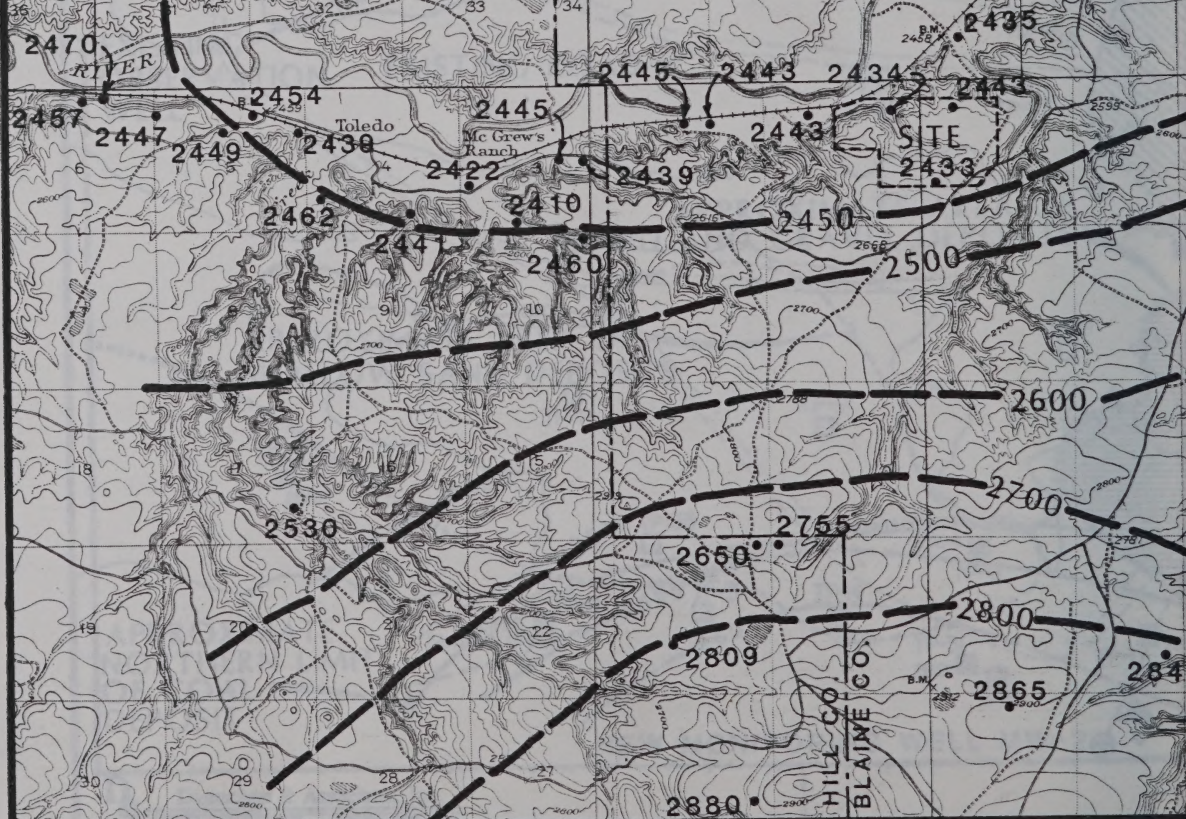
BASE: Havre and Yantic
15 Min. USGS Quad.

Unified Dispos

Report of Monitoring
and Hydrogeologic
January,

Havre
5 Miles

HILL CO.
BLAINE CO.





February 3, 1992

Mr. Jim Wilbur
Solid and Hazardous Waste Bureau
Montana Department of Health
and Environmental Sciences
836 Front Street
Helena, Montana 59620

RECEIVED

FEB 04 1992

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

RE: Transmittal of Havre Landfill Review Comments

Dear Mr. Wilbur:

PRC Environmental Management, Inc., (PRC) is pleased to submit comments pertaining to the Havre municipal solid waste landfill. PRC reviewed the following documents:

1. "Hydrogeologic Analysis for the Existing Sanitary Landfill," October 1991 prepared by Damschen & Associates.
2. "Construction Plans" (Sheets 1 through 15), December 1989, Havre Landfill analysis and design prepared by Damschen & Associates.

PRC has welcomed the opportunity to work with the SHWB on this project and the Butte - Silver Bow landfill project. If you have any questions pertaining to this submittal, or if PRC can be of further assistance to SHWB in the future, please call me at (406) 442-5588.

Sincerely,

PRC ENVIRONMENTAL MANAGEMENT, INC.

A handwritten signature in dark ink, reading "David A. Donohue". The signature is fluid and cursive, with the first name "David" and last name "Donohue" clearly legible.

David A. Donohue
Hydrogeologist

Enclosure

cc: PRC file





February 3, 1992

Mr. Jim Wilbur
Solid and Hazardous Waste Bureau
Montana Department of Health
and Environmental Sciences
836 Front Street
Helena, Montana 59620

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FEB 04 1992

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

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Sincerely,

PRC ENVIRONMENTAL MANAGEMENT, INC.

A handwritten signature in cursive script that reads "David A. Donohue". The ink is dark and the signature is fluid.

David A. Donohue
Hydrogeologist

Enclosure

cc: PRC file

TEXT - GENERAL COMMENTS

The "Hydrogeologic Analysis for the Existing Sanitary Landfill (Havre, Montana)", prepared by Damschen and Associates, Inc. fulfills most of the State of Montana requirements for landfill application investigations. The report, however, contains several errors, omissions, and contradictions, which raises concern about the report findings and the conclusions. Many of the contradictions are fundamental in nature and affect the conclusions regarding ground water contamination. This document provides general and specific text and drawing comments for use by the State of Montana in assessing the adequacy of the Havre analysis.

SPECIFIC COMMENTS

1. Report Title. The report title reflects a hydrogeologic analysis for the existing landfill. The report is actually an analysis of the existing 25-acre landfill and a lateral expansion landfill located on an abutting 40 acres.
2. Table of Contents. Section IV(B(2)(d) entitled Blood Pit, is not included in the report, but appears in the table of contents. Appropriate text regarding the blood pit should be added to the report or the section should be deleted from the table of contents.
3. Page 3, Section 2, first paragraph. The second sentence in this paragraph states the investigation was conducted during a period of unusually high rainfall. To substantiate the claim, the report should compare local rainfall records for the investigation period to the historical average rainfall during the same period. Local climatological records should also be used to prepare a landfill water balance as an aid to assessing potential landfill leachate generation.
4. Page 5, Section B, second paragraph. This paragraph describes the methods used to evaluate shallow ground water elevations on the south side of the site. The fourth sentence states that, to obtain ground water elevations, the measured depth to ground water was correlated to surveyed test pit elevations. Site surveys should determine the elevation of the top of the perforated pipe placed in each excavation to obtain accurate ground water elevation measurements.

The fifth sentence states that the measured ground water elevation data were combined with data estimating elevation of ground water seeps on the cut slope in the active landfill area. The data were used to develop a ground water potentiometric surface map (Plate 2). However, this map does not appear to incorporate the ground water seep elevations. It is appropriate that the shallow ground water potentiometric surface be determined using all available data. The seep elevations should be surveyed and the survey data should be incorporated into the potentiometric surface map.

5. Page 7, Section E, first paragraph. The first sentence states that water samples were collected from standpipes in test pits 5, 16, and 27. Yet the test pit logs in Appendix E and the test pit symbols on Plate 2 indicate no water was detected in test pits 5 and 16. The report should explain this discrepancy. If water was detected in test pits 5 and 16, the pits' respective ground water elevations should be incorporated into the shallow ground water potentiometric surface map on Plate 2. Also, Appendix H presents water analysis results for test pits 16 and 27 only. Appendix H should present analyses for test pit 5, if pit 5 did contain water. Water analysis data for test pit 16 show total dissolved solids (TDS) of 13,000 milligrams per liter (mg/l); sulfate of 7,910 mg/l; and chloride of 645 mg/l. The report should explain this difference in ground water quality if the water came from the same water bearing unit. Also, the water analyses presented should be complete so that anion-cation balances can be performed to check laboratory results.

6. Page 7, Section E, second paragraph. The first sentence states that water samples collected from test pits 16, 27, and the existing observation well were analyzed to evaluate contaminants which migrated through the landfill into shallow ground water. The shallow ground water potentiometric map, however, indicates the locations of test pits 5 and 16 are not directly downgradient of the landfill. The shop well and the observation well are screened in the bedrock aquifer not the shallow landfill aquifer. According to Plate 1, the potentiometric gradient of the bedrock aquifer is northeast. These two bedrock wells, therefore, are not downgradient of the present landfill and are not screened in the shallow aquifer. Another investigation should be performed to evaluate contamination which migrated through the landfill into shallow groundwater. The investigation should gather sufficient data to (1) determine the gradient of the shallow aquifer, (2) collect ground water samples from boreholes or monitoring wells screened in the shallow aquifer upgradient and downgradient of

the present landfill, (3) determine the local gradient of the bedrock aquifer, (4) collect ground water samples from monitoring wells screened in the bedrock aquifer upgradient and downgradient of the present landfill, and (5) determine the vertical gradients and potential for hydrologic interconnection between the shallow aquifer and bedrock aquifer..

7. Page 7, Section E, third paragraph. This paragraph states water samples were collected from monitoring wells MW-1, MW-2, and the shop well and were analyzed for Resource Conservation and Recovery Act (RCRA) Subtitle D chemical parameters. The paragraph also states the purpose of the analysis was to evaluate the landfill's impact on the bedrock aquifer. The measured elevations of the ground water in these three wells indicate the potentiometric surface of the bedrock aquifer slopes to the southwest. There is insufficient data to determine whether leachate from the present landfill has impacted the bedrock aquifer. The shop well may not be suitable for use as a monitoring well because it may not be located upgradient or downgradient of the current landfill or the proposed landfill and is not suitable because it is located more than 1,000 feet from the present landfill boundary.

The report should include sufficient data points to determine the gradient of the bedrock aquifer and provide analysis of water samples collected from monitoring wells upgradient and downgradient of the present landfill. According to Montana Code Amendment 75-10-207, Rule IV, a minimum of three downgradient monitoring wells and one upgradient monitoring well must be installed into the uppermost aquifer to monitor landfill leachate contamination in the aquifer. Plate 2 indicates that monitoring wells MW-1 and MW-2 are located more than 800 feet north and south, respectively, of the present landfill boundary. The downgradient wells should be located within close proximity of the landfill boundary. According to Title 40 Code of Federal Regulations (CFR) 258.40(d), the monitoring wells shall not be located more than 150 meters from the landfill boundary and shall be located on land owned by the owner of the landfill.

8. Page 10, Section 2, second paragraph. This paragraph describes structural geological features identified in the region and infers a site-specific conclusion. As described, the conclusions are not logical. The text should be revised, or a figure should be included in the report to illustrate the conclusion.

9. Page 21, Section B, third paragraph. The paragraph describes the hydrogeological interpretation of the bedrock aquifer at the site. The data in Table 1 indicate that the water-bearing interval in MW-2 and in the shop well have elevations of 2,394 feet and 2,396 feet, respectively. According to the information presented in the geological section, the bedrock dips to the northeast. This water-bearing interval is approximately on a strike line between these two wells. Yet the paragraph states the water bearing units in these wells are not connected. The report should be revised to address the apparent stratigraphic relationship of the water-bearing sandstone at these locations.

The report also indicates that the bedrock aquifer is used downgradient of the site. The report, therefore, should include sufficient data to determine, with reasonable certainty, the gradient of bedrock ground water beneath the site and evaluate the potential impact of leachate from the present landfill on this aquifer.

10. Page 23, Section D, first paragraph. This paragraph summarizes the methods used to estimate the hydraulic properties of the bedrock aquifer. The text should include the field data used to estimate the hydraulic properties and the analytical formulae used to calculate transmissivity. The text should also summarize the field methods used to measure the aquifer response to water removal. The text, for instance, should describe: (1) how the water was removed, (2) the volume of water removed, and (3) the water level measurement methods, frequency, and total number of measurements. The calculations should be appended to the report.
11. Page 24, Section E, fourth paragraph. This paragraph describes the vertical movement of water through the unsaturated sandstone bedrock beneath the site and states that the flow time through the sandstones can be ignored. The text considers unsaturated flow in the vertical direction only. In sedimentary sequences, unsaturated flow can be influenced by lithologic changes. According to the report discussion, the bedrock formation is a fluvial deposit. Typically, fluvial deposits contain sharp lithologic boundaries at the bottom of sand channels. The sand directly overlies the fine-grained sediment. If leachate were to enter a sandstone body under unsaturated conditions, it would flow vertically through the sandstone until it came in contact with the underlying shale, then it would migrate laterally and downgradient along the sandstone preferential flow path. The report should acknowledge the effect of

preferential flow paths in the unsaturated zone. The calculations should not ignore transport through the sandstone intervals.

12. Page 27, Table 3. As noted earlier on Plate 2, test pit 5 is shown as dry. Table 3 contradicts this and no supporting laboratory analyses data are presented. Test pit 16 is also shown as dry on Plate 2, but is shown as upgradient (actually downgradient) and water analyses are provided. These contradictions, and the laboratory analyses for duplicate samples presented in Appendix I, lead one to question the water analyses from these 2 locations. See comment 6 recommendations.
13. Appendix E. This appendix contains the test pit logs. The log descriptions are very brief and are incomplete. For instance TP-1 describes the 11 to 12.7 foot interval as red, and the 12.7 to 15 foot interval as light. Numerous logs contain single letters in parentheses after the rock descriptions, yet the meaning of the letters is not defined. The logs should be revised to include complete soil or rock descriptions, and all symbols should be referenced or defined.

DRAWINGS - GENERAL COMMENTS (SHEETS 1 THROUGH 15)

No construction details are presented for leachate collection and treatment or gas migration monitoring and interception. These details should be provided following further analysis.

SPECIFIC COMMENTS

1. Sheet 2. No scale is given in this drawing. It is recommended that horizontal and vertical control be given for property pins. This sheet depicts test pit 5 with water; Plate 2 in the text notes it to be dry. Similarly, this sheet shows test pit 17 as dry; Plate 2 shows water. See specific comments 6 and 12 on the hydrogeologic analysis report.
2. Sheet 3. The natural gas pipeline noted probably has an easement. The gas line intersection coordinates with the property line should be noted. No perimeter fencing is noted on the drawing. An easement/title to the access road should be analyzed. The sheet shows a gate relocation and new access road on abutting private property. Also, access road construction

details should be given. The sheet shows two surface water detention ponds. One reflects a dam height of approximately 20 to 25 feet and the other dam approximately 30 to 35 feet high. A site water balance should be completed. Surface water runoff calculations and pond sizing should also be completed and presented for review.

3. Sheet 5. This sheet indicates shallow ground water interception and conveyance to private property east of the landfill area. Surface drainage will also be conveyed across private property to the east. Ground and surface water should be collected and routed to the west on district property. No easterly surface water detention is shown. The final contours proposed result in slopes of ± 10 percent for the existing landfill area. Erosion and slope stability analyses should be performed to determine the acceptability of these slopes. At the proposed ground water subdrain and gas line intersection, the contours indicate that the gas line is spanning the ditch. The contours should be revised. Similarly, the subdrain and gravel pit access road intersection contours should be changed. The current drawing assumes that the access road will be retained.
4. Sheet 6. This sheet shows the subdrain and gas line intersection to include a 100-foot corrugated metal pipe (CMP) and dike to retain the gas line. The saturated condition of these soils may make this dike unstable. The gas line company probably has an easement with which this plan must be consistent. The district, therefore, must have permission to construct as planned. The sheet indicates that the access road has been abandoned. This should be confirmed by those using the road. The subdrain will, as noted earlier, convey ground water (and surface water) to private property on the east. It is recommended that the subdrain grade be revised and all surface and ground water drainage be confined to district property. The subdrain, as depicted, varies in elevation from $\pm 2,587$ feet to $\pm 2,575$ feet. Ground water below these elevations will continue to migrate north through the existing landfill. This ground water should be intercepted or leachate collection provided below the existing landfill. Slope stake limits for the subdrain should be included on this sheet. The subdrain excavation will be in water and trench stability issues should be addressed.
5. Sheet 15. The existing ground water level is reportedly at an elevation of $\pm 2,590$ feet. The subdrain on Sheet 6 is at an elevation of $\pm 2,587$ feet to $\pm 2,575$ feet. The existing landfill contains trash below elevation ± 2575 feet, which will continue to be saturated with the

subdrain proposed. A method to prevent continued saturation of the trash should be presented.

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCE

TO:

Prov
Ed T ✓

DATE:

15 June 9

1.

2.

3.

Jan D JO

Roger pety 29/8

☒ Approval

☐ Comment

☐ Necessary A

☐ Note and Return

☐ Note and File

☐ Investigate

☐ Prepare reply

☐ Signature

☐ See Me

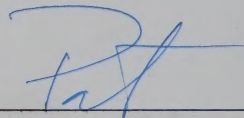
☐ As requested

☐ For your information

☐ Per Convers

REMARKS:

FROM:



mailed
6-18

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program
(406) 444-1430

MARC RACICOT, GOVERNOR

FAX # (406) 444-1499



STATE OF MONTANA

OFFICE 836 Front Street
LOCATION Helena, Montana

MAILING PO BOX 200901
ADDRESS: Helena, MT 59620-0901

June 15, 1993

Bruce L. Siegmund
Damschen and Associates
P.O. Box 4817
Helena, MT 59604

Dear Bruce:

Your request for a 45 day extension for the completion of the ground water monitoring network and SAP for the Unified Disposal District at Havre, MT is granted.

Please remember that the SAP should list the updated Table 1 analytes from the recent rulemaking in order to simplify the transition on October 9. Also the initial sampling event may require more than one sample from each well in order to establish the statistical basis for exceedence. The Guidance Document on the Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, USEPA (1989), should be used for that determination.

If you have any other questions on this matter, please feel free to contact me.

Sincerely,

A handwritten signature in cursive script, reading "F. Patrick Crowley".

F. Patrick Crowley
Environmental Specialist IV

Enclosure

cc: Unified Disposal District

File:unified \groundwater\extension
Path:H:\franko\wp\landfill\grndwatr\unified.ext

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: Proof [#] W DATE: 11/4/92

1. Jim W

2. Pat C

3. Duane ^{P/R}

- | | | |
|--|---|---|
| ☒ Approval | ☐ Comment | ☐ Necessary Action |
| ☐ Note and Return | ☐ Note and File | ☐ Investigate |
| ☐ Prepare reply | ☐ Signature | ☐ See Me |
| ☐ As requested | ☐ For your information | ☐ Per Conversation |

REMARKS:

sw/ unified.wkr

Note: Jon D. approved this 10/21/92.
(see below)

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: Jon D ✓ DATE: 10/21/92

1. Pat C

2. Jim W

3. Roger 4 Duane

- | | | |
|--|---|---|
| ☒ Approval | ☐ Comment | ☐ Necessary Action |
| ☐ Note and Return | ☐ Note and File | ☐ Investigate |
| ☐ Prepare reply | ☐ Signature | ☐ See Me |
| ☐ As requested | ☐ For your information | ☐ Per Conversation |

REMARKS:

FROM: f³

mailed
11-6-92
eh

Steel Co.

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES

Solid and Hazardous Waste Bureau

Solid Waste Program

STAN STEPHENS, GOVERNOR

(406) 444-1430

FAX #(406) 444-1499



STATE OF MONTANA

OFFICE 836 Front Street
LOCATION: Helena, Montana

MAILING Cogswell Building
ADDRESS: Helena, MT 59620

November 5, 1992

Larry Broere, Manager
Unified Disposal Board
Hill County Courthouse
Havre, Montana 59501

RE: UNIFIED DISPOSAL DISTRICT LANDFILL, LICENSE NO.222 -
REVIEW AND APPROVAL OF THE WORKPLAN FOR THE HYDROGEOLOGICAL
AND SOILS STUDY.

Dear Mr. Broere:

Upon review by the Montana Department of Health and Environmental Sciences, Solid Waste Program (the Department) of the Workplan dated October 9, 1992 presented by Damschen and Associates, Inc. on the above referenced landfill facility and the associated proposed expansion area to the north, the following items need to be addressed in greater detail and/or clarified:

INTRODUCTION - LOCATION AND DESCRIPTION OF THE LANDFILL SITE

1. Explain why the areal extent of the landfill has not changed much since 1989? Is this because the waste disposal method has progressed to an area-fill method?

HYDROGEOLOGIC AND SOILS INVESTIGATION

2. Objective #4 should state that at the present time the groundwater monitoring network proposed for the existing disposal area, may or may not be related to the monitoring network requirements at the expansion areas. The multi-phased approach and the explanation of this plan is adequately addressed later in the Workplan (i.e. Phase II: Groundwater Monitoring Network).

PHASE I: FIELD INVESTIGATIONS

3. According to previous information submitted to the Department (see Damschen Report, 10/91, "Hydrogeological Analysis for the Existing Sanitary landfill"), the size of the active, licensed disposal site is 25 acres, and the adjacent expansion area to the north is 40 acres. The Workplan states that the site characterization is for a 50 acre site. Can you explain this discrepancy in area? The main concern being concentrated on the accurate specifications of the expansion area to insure an

adequate number of borings and backhoe pits will be done in and around this area to determine design requirements and conditions (if any) of final license issuance.

4. There are 16 test pit locations displayed on Plate 2 of the Workplan. The text states 15 test pits will be excavated. Which one of the 16 test pits on the map do you plan to eliminate, and why?

TEST BORINGS

5. Identify for purposes of clarity, the 3 test borings that:

"have been drilled proximal to the waste area",

as, TB 1, 2, & 3.

6. Paragraph 4.

If deep, regional test borings (i.e. TB 8 & TB 9) are required for further evaluation of the regional aquifer at the expansion area, wouldn't these test borings be completed as monitoring wells and if so, would you expect (with the limited subsurface data available, to date) that TB 8 might function as a background monitoring well location?

7. Paragraph 6.

Describe the type of permeability tests you plan to conduct. Of these tests, how many will be laboratory tests and what method and parameters will be used? Concerning field permeability tests, explain approximately how many tests will be conducted, what test method will be used, and what will be the proposed duration of these tests for each of the following scenarios:

(a) the shallow water unit(s) associated with the active area, and

(b) the deep regional aquifer, if used for groundwater monitoring.

8. Plate 1.

Contouring, in relation to honoring the data points on this map, is poor. This map should not be used as a valid representation of the "Vicinity Hydrogeology Map of the Judith River Aquifer" in the final report, unless it is corrected.

The following is a general comment to attempt to eliminate any confusion concerning temporarily open (i.e. uncased) boreholes at the site during the hydrogeologic and soils field investigation.

The Department policy/regulations, Water Quality Bureau regulations, and the Board of Water Well Contractors rules all enforce the need to case the open holes of any borings that may possibly be intended to be used as groundwater monitoring wells. This is especially true when excavating and/or drilling in the area of an active or once active (i.e. closed) landfill or solid waste disposal facility.

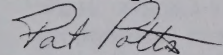
Shallow seepage (water and/or leachate) may collect on the sides of an open borehole and run down the inside, collecting and commingling at first-water, and in some cases in the zone of the uppermost aquifer. These open/uncased boreholes can act as a conduit for shallow contaminant migration [see the Administrative Rules of Montana (ARM) 16.14.705(6)].

This site appears to offer a hydrogeologically diverse setting. Natural diversity can be observed in the shallow water bearing units present to the south of the active waste disposal area which appears to drain to the west. To the north, in the expansion area, the first water-bearing unit may be the deeper, regional Judith River Formation and associated aquifer(s). Hydrogeological diversification has occurred artificially at the site as well, through the disturbance of the soils for waste disposal, and the man-made drain constructed along the southern boundary of the active waste disposal unit to carry the shallow groundwater away from the buried waste.

The Department is in full realization of the dynamic nature of this particular investigation and hopes to be able to support all technically based decisions as they evolve throughout the study.

The Department **approves** the Workplan as presented, however the above comments, questions, inadequacies and deficiencies need to be addressed in writing within 15 calendar days from the receipt of this letter, according to ARM 16.14.703(1)(c)(ii)(B).

Sincerely,



Pat Potts

Environmental Specialist

file:sw\unified.wkr

cc: Damschen and Associates, Inc., P.O. Box 4817, Helena, MT 59604
Clay Vincent, R.S., County Courthouse, Havre, MT 59501
Marty Dirden, R.S., Courthouse, Box 576, Chinook, MT 59523

P 552 426 893

RECEIPT FOR CERTIFIED MAIL

NO INSURANCE COVERAGE PROVIDED
NOT FOR INTERNATIONAL MAIL
(See Reverse)

U.S.G.P.O. 1989-234-555

PS Form 3800, June 1985

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Street and No.	Courthouse	
P.O. State and ZIP Code	Havre, MT 59501	
Postage	\$	
Certified Fee		
Special Delivery Fee		
Restricted Delivery Fee		
Return Receipt showing to whom and Date Delivered		
Return Receipt showing to whom, Date, and Address of Delivery		
TOTAL Postage and Fees	\$	
Postmark or Date	8-3-92	

Hill Co.

ROUTE SLIP #222

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: Proof LH DATE: 7/31/92
 1. Jim W
 2. Jon D JD
 3. Duane

- | | | |
|--|---|---|
| ☐ Approval | ☐ Comment | ☐ Necessary Action |
| ☐ Note and Return | ☐ Note and File | ☐ Investigate |
| ☐ Prepare reply | ☐ Signature | ☐ See Me |
| ☐ As requested | ☐ For your information | ☐ Per Conversation |

REMARKS:

Form-letter.
 "New Staff" = para 1
 para 2 (first part)
 last 2 paragraphs
 mailed 8-3-92 en

FROM: P3

SENDER:

- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt Fee will provide you the signature of the person delivered to and the date of delivery.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
 2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Unifid Disposal Bd
 Hill Co. Health & Planning
 Office
 Courthouse
 Havre, MT 59501

5. Signature (Addressee)

6. Signature (Agent)

4a. Article Number

552 426 839

4b. Service Type

- | | |
|---|---|
| ☐ Registered | ☐ Insured |
| ☒ Certified | ☐ COD |
| ☐ Express Mail | ☐ Return Receipt for Merchandise |

7. Date of Delivery

8-4-92

8. Addressee's Address (Only if requested and fee is paid)

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program
(406) 444-1430

STAN STEPHENS, GOVERNOR

FAX #(406) 444-1499



STATE OF MONTANA

OFFICE 836 Front Street
LOCATION: Helena, Montana

MAILING Cogswell Building
ADDRESS: Helena, MT 59620

August 3, 1992

CERTIFIED MAIL

Unified Disposal Board
Hill County Health and Planning Office
Courthouse
Havre, Montana 59501

RE: UNIFIED DISPOSAL DISTRICT CLASS II LANDFILL - LICENSE NO. 222
HYDROGEOLOGICAL AND SOILS STUDY/REPORT, GROUNDWATER
MONITORING PLAN, & GROUNDWATER SAMPLING AND ANALYSIS
PLAN.

Dear Sirs:

The meeting on July 31, 1992 provided an excellent opportunity for all parties involved with the above referenced facility to ask questions, exchange ideas and discuss future objectives at this site. The geology and the hydrogeology in this area is quite complex, making this a somewhat difficult site to monitor as effectively as may be necessary to detect contaminant constituent migration in the groundwater. Immediate concern must be focused on developing a shallow groundwater monitoring system to adequately detect any contaminant constituents emanating from the existing waste disposal area through direct migration of leachate into the groundwater. Initial groundwater analysis from the deep aquifer in this area may also indicate possible impacted groundwater conditions.

Based on the above concerns, it is critical that work begin on establishing an adequate and effective groundwater monitoring system at this facility as soon as possible. Groundwater monitoring is a requirement at the Unified Disposal District Class II landfill, according to the criteria that have been established in 75-10-207 of the Montana Code Annotated (MCA) for municipal solid waste landfills and other disposal sites. The Montana Department of Health and Environmental Sciences, Solid Waste Program (the Department) is formally notifying the Unified Disposal Board

that the above referenced landfill must comply with the Administrative Rules of Montana (ARM), Title 16, Chapter 14, Subchapter 7, Groundwater Monitoring Regulations. The specific points of compliance are discussed below.

Hydrogeological and Soils Study

The Unified Disposal District Class II Landfill is required to monitor the groundwater based on the following: the landfill has accepted household waste, it was in operation as of October 1, 1989 and serves an area with a population of 5,000 or more persons (see 75-10-207, MCA). Therefore, the Department, according to the Administrative Rules of Montana (ARM) 16.14.703(1)(c)(ii) requires the owner/operator of this solid waste disposal facility to provide a Hydrogeological and Soils Study/Report (see ARM 16.14.703) to the State. The culmination of this report should center on the installation of groundwater monitoring wells (locations to be defined according to ARM 16.14.704), in an effort to establish an adequate and accurate groundwater monitoring network [see ARM 16.14.707(1)(b)].

Workplan

A Workplan for this Study/Report must be presented to the State for approval within 90 calendar days from the date of this formal notification letter [see ARM 16.14.703(1)(c)(ii)(A)]. The Workplan should outline necessary research, field activities, locations of the proposed soil borings/test pits and groundwater monitoring well installations, as well as any lab and/or field tests needed to meet the data requirements for the final Hydrogeological Study/Report.

Please note the specific ARM standards for the number of borings and/or test pits required at the site [see ARM 16.14.703(1)(a)(x)(K)(III)], location and number of groundwater monitoring wells (see ARM 16.14.704), and the construction standards/requirements for groundwater monitoring wells (see ARM 16.14.705) to be installed around the perimeter of the waste disposal area(s). A deviation from the required number of borings and/or test pits may be requested in the Workplan, as long as adequate geologic, soils and hydrologic characterization of the site can be provided. A schedule of the dates for each event (e.g. soil borings and/or backhoe pits, groundwater monitoring well installations and development, etc.) must also be incorporated in the Workplan.

Following State approval of the Workplan, the necessary operations, tests, and studies can begin in an effort to finalize the complete Hydrogeological and Soils Study/Report and a Groundwater Monitoring Plan. As stated in ARM 16.14.703(1)(c)(ii)(C), this report must be submitted no later than 180 days after the Workplan is approved by the Department.

Groundwater Monitoring Plan

Coincident with groundwater monitoring well installations around the perimeter of the waste disposal areas as required in the Hydrogeological and Soils Study/Report, a Groundwater Monitoring Plan, according to ARM 16.14.707(1)(b) must be submitted.

The groundwater monitoring network will be defined in this report [see ARM 16.14.707(1)(b)(i)], approximate dates for sampling the monitoring wells will be provided [see ARM 16.14.707(1)(b)(ii)], and any updates or revisions to the groundwater monitoring plan due to possible changes in the groundwater conditions at the site [see ARM 16.14.707(1)(b)(iii)] will be included in this Plan.

Sampling and Analysis Plan

Following installation and approval of the groundwater monitoring well network and prior to any groundwater sampling or well monitoring activities in and around the facility, be advised that a Sampling and Analysis Plan (SAP) is required by the State (see ARM 16.14.706). This SAP must be approved in writing by the State prior to implementation. Please note the specified groundwater sampling and measurement frequencies defined in the ARM 16.14.706(4). All wells must be surveyed to mean sea level or a local datum [see ARM 16.14.707(5)]. Minimum required groundwater chemical constituents/sampling parameters are listed in Table I of ARM 16.14.706.

Conclusions

Enclosed is a copy of the most current (12/31/91) Solid Waste Groundwater Monitoring Regulations for the State of Montana (i.e. Subchapter 7), a copy of the standard groundwater monitoring well construction diagram and groundwater monitoring well development form. Please review this information carefully.

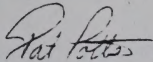
The Unified Disposal District Class II Landfill Workplan submittal will be due 90 calendar days from the date of this letter, or no later than November 5, 1992. Submittal date for the final, completed Hydrogeological and Soils Study/Report accompanied by the Groundwater Monitoring Plan must follow 180 days after the Department's approval of the Workplan.

August 3, 1992

Page 4

Please give me a call if you have any questions pertaining to this formal notification and/or the ARM Subchapter 7 regulations. Thank you for your time and patience in the preliminary planning and informational meeting last week. I look forward to working with you and visiting this facility in the near future.

Sincerely,



Pat Potts
Environmental Specialist

Enclosures: ARM Subchapter 7
 Groundwater Monitoring Well Construction Diagram
 Groundwater Monitoring Well Development Form

cc: Clay Vincent, R.S., Hill County Sanitarian, County Courthouse, Havre, MT
 59501

Marty Dirden, R.S., Blaine County Sanitarian, Courthouse, Box 576, Chinook,
MT 59523

Larry Broere, Manager, Unified Disposal, Hill County Health and Planning,
Hill County Courthouse, Havre, MT 59501

Barry Damschen, Damschen & Associates, Inc., 2030 11th Avenue, Suite 11.
P.O. Box 4817, Helena, MT 59604

file: sw\unified.gwt

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO:

DATE:

2/25/92

1.

2.

3.

☒ Approval

☐ Comment

☐ Necessary Action

☐ Note and Return

☐ Note and File

☐ Investigate

☐ Prepare reply

☐ Signature

☐ See Me

☐ As requested

☐ For your information

☐ Per Conversation

REMARKS:

Response to Unified Disposal
Hydrologic & Expansion
Districts plans.

FROM:

mailed
3-5-92
en

J.T.

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES

Solid and Hazardous Waste Bureau

Solid Waste Program

STAN STEPHENS, GOVERNOR (406) 444-1430

FAX #(406) 444-1499



STATE OF MONTANA

OFFICE 836 Front Street
LOCATION: Helena, Montana

MAILING Cogswell Building
ADDRESS: Helena, MT 59620

March 3, 1992

Clay Vincent, R.S.
Unified Disposal District
Hill County Courthouse
Havre, MT. 59501

SUBJECT: Review of Hydrogeologic Analysis for the Existing Sanitary Landfill,
Unified Disposal District, Havre, Montana, October, 1991

Mr. Vincent:

We have reviewed your report and prepared the following comments and questions.

TEXT - GENERAL COMMENTS

The "Hydrogeologic Analysis for the Existing Sanitary Landfill (Havre, Montana)", prepared by Damschen and Associates, Inc. fulfills most of the State of Montana requirements for landfill application investigations. The report, however, contains several errors, omissions, and contradictions, which raises concern about the report findings and the conclusions. Many of the contradictions are fundamental in nature and affect the conclusions regarding ground water contamination.

SPECIFIC COMMENTS

1. Report Title. The report title reflects a hydrogeologic analysis for the existing landfill. The report is actually an analysis of the existing 25-acre landfill and a lateral expansion landfill located on an abutting 40 acres.
2. Table of Contents. Section IV(B)(2)(d) entitled Blood Pit, is not included in the report, but appears in the table of contents. Appropriate text regarding the blood pit should be added to the report or the section should be deleted from the table of contents.
3. Page 3, Section 2, first paragraph. The second sentence in this paragraph states the investigation was conducted during a period of unusually high rainfall. To substantiate the claim, the report should compare local rainfall records for the investigation period to the historical average rainfall during the same period. Local climatological records should also be used to prepare a landfill water balance as an aid to assessing potential landfill leachate generation. Information should be given regarding a 24 hour/25 year storm event.

4. Page 5, Section B, second paragraph. This paragraph describes the methods used to evaluate shallow ground water elevations on the south side of the site. The fourth sentence states that, to obtain ground water elevations, the measured depth to ground water was correlated to surveyed test pit elevations. Site surveys should determine the elevation of the top of the perforated pipe placed in each excavation to obtain accurate ground water elevation measurements.

The fifth sentence states that the measured ground water elevation data were combined with data estimating elevation of ground water seeps on the cut slope in the active landfill area. The data were used to develop a ground water potentiometric surface map (Plate 2). However, this map does not appear to incorporate the ground water seep elevations. It is appropriate that the shallow ground water potentiometric surface be determined using all available data. The seep elevations should be surveyed and the survey data should be incorporated into the potentiometric surface map.

5. Page 7, Section E, first paragraph. The first sentence states that water samples were collected from standpipes in test pits 5, 16, and 27. Yet the test pit logs in Appendix E and the test pit symbols on Plate 2 indicate no water was detected in test pits 5 and 16. The report should explain this discrepancy. If water was detected in test pits 5 and 16, the pits' respective ground water elevations should be incorporated into the shallow ground water potentiometric surface map on Plate 2. Also, Appendix H presents water analysis results for test pits 16 and 27 only. Appendix H should present analyses for test pit 5, if pit 5 did contain water. Water analysis data for test pit 16 show total dissolved solids (TDS) of 13,000 milligrams per liter (mg/l); sulfate of 7,910 mg/l; and chloride of 645 mg/l. The report should explain this difference in ground water quality between pits 16 & 27 if the water came from the same water bearing unit. Also, the water analyses presented should be complete so that anion-cation balances can be performed to check laboratory results.
6. Page 7, Section E, second paragraph. The first sentence states that water samples collected from test pits 16, 27, and the existing observation well were analyzed to evaluate contaminants which migrated through the landfill into shallow ground water. The shallow ground water potentiometric map, however, indicates the locations of test pits 5 and 16 are not directly downgradient of the landfill. The shop well and the observation well are screened in the bedrock aquifer not the shallow landfill aquifer. According to Plate 1, the potentiometric gradient of the bedrock aquifer is northeast. These two bedrock wells, therefore, are not downgradient of the present landfill and are not screened in the shallow aquifer. Another investigation should be performed to evaluate contamination which migrated through the landfill into shallow groundwater. The investigation should gather sufficient data to (1) determine the gradient of the shallow aquifer, (2) collect ground water samples from boreholes or monitoring screened in the shallow aquifer upgradient and downgradient of the bedrock aquifer, (3) determine the local gradient of the bedrock aquifer, (4) collect ground water samples from monitoring wells screened in the bedrock aquifer upgradient and downgradient of the present landfill, and (5) determine the vertical gradients and potential for hydrologic interconnection between the shallow aquifer and bedrock aquifer.

7. Page 7, Section E, third paragraph. This paragraph states water samples were collected from monitoring wells MW-1, MW-2, and the shop well and were analyzed for Resource Conservation and Recovery Act (RCRA) Subtitle D chemical parameters. The paragraph also states the purpose of the analysis was to evaluate the landfill's impact on the bedrock aquifer. The measured elevations of the ground water in these three wells indicate the potentiometric surface of the bedrock aquifer slopes to the southwest. There is insufficient data to determine whether leachate from the present landfill has impacted the bedrock aquifer. The shop well may not be suitable for use as a monitoring well because it may not be located upgradient or downgradient of the current landfill or the proposed landfill and is not suitable because it is located more than 1,000 feet from the present landfill boundary.

The report should include sufficient data points to determine the gradient of the bedrock aquifer and provide analysis of water samples collected from monitoring wells upgradient and downgradient of the present landfill. According to Montana Code Amendment 75-10-207, Rule IV, a minimum of three downgradient monitoring wells and one upgradient monitoring well must be installed into the uppermost aquifer to monitor landfill leachate contamination in the aquifer. Plate 2 indicates that monitoring wells MW-1 and MW-2 are located more than 800 feet north and south, respectively, of the present landfill boundary. The downgradient wells should be located within close proximity of the landfill boundary. According to Title 40 Code of Federal Regulations (CFR) 258.40(d), the monitoring wells shall not be located more than 150 meters from the landfill boundary and shall be located on land owned by the owner of the landfill.

8. Page 10, Section 2, second paragraph. This paragraph describes structural geological features identified in the region and infers a site-specific conclusion. As described, the conclusions are not logical. The text should be revised, or a figure should be included in the report to illustrate the conclusion.
10. Page 21, Section B, third paragraph. The paragraph describes the hydrogeological interpretation of the bedrock aquifer at the site. The data in Table 1 indicate that the water-bearing interval in MW-2 and in the shop well have elevations of 2,394 feet and 2,396 feet, respectively. According to the information presented in the geological section, the bedrock dips to the northeast. This water-bearing interval is approximately on a strike line between these two wells. Yet the paragraph states the water bearing units in these wells are not connected. The report should be revised to address the apparent stratigraphic relationship of the water-bearing sandstone at these locations.

The report also indicates that the bedrock aquifer is used downgradient of the site. The report, therefore, should include sufficient data to determine, with reasonable certainty, the gradient of bedrock ground water beneath the site and evaluate the potential impact of leachate from the present landfill on this aquifer. This paragraph summarizes the methods used to estimate the hydraulic properties of the bedrock aquifer. The text should include the field data used to estimate the hydraulic properties and the analytical formulae used to calculate transmissivity.

10. Page 23, Section D, first paragraph, continued. The text should also summarize the field methods used to measure the aquifer response to water removal. The text, for instance, should describe: (1) how the water was removed, (2) the volume of water removed, and (3) the water level measurement methods, frequency, and total number of measurements. The calculations should be appended to the report.
11. Page 24, Section E, fourth paragraph. This paragraph describes the vertical movement of water through the unsaturated sandstone bedrock beneath the site and states that the flow time through the sandstones can be ignored. The text considers unsaturated flow in the vertical direction only. In sedimentary sequences, unsaturated flow can be influenced by lithologic changes. According to the report discussion, the bedrock formation is a fluvial deposit. Typically, fluvial deposits contain sharp lithologic boundaries at the bottom of sand channels. The sand directly overlies the fine-grained sediment. If leachate were to enter a sandstone body under unsaturated conditions, it would flow vertically through the sandstone until it came in contact with the underlying shale, then it would migrate laterally and downgradient along the sandstone preferential flow path. The report should acknowledge the effect of preferential flow paths in the unsaturated zone. The calculations should not ignore transport through the sandstone intervals.
12. Page 27, Table 3. As noted earlier on Plate 2, test pit 5 is shown as dry. Table 3 contradicts this and no supporting laboratory analyses data are presented. Test pit 16 is also shown as dry on Plate 2, but is shown as upgradient (actually downgradient) and water analyses are provided. These contradictions, and the laboratory analyses for duplicate samples presented in Appendix I, lead one to question the water analyses from these 2 locations. See comment 6 recommendations.
13. Appendix E. This appendix contains the test pit logs. The log descriptions are very brief and are incomplete. For instance TP-1 describes the 11 to 12.7 foot interval as red, and the 12.7 to 15 foot interval as light. Numerous logs contain single letters in parentheses after the rock descriptions, yet the meaning of the letters is not defined. The logs should be revised to include complete soil or rock descriptions, and all symbols should be referenced or defined.

DRAWINGS - GENERAL COMMENTS (SHEETS 1 THROUGH 15)

No construction details are presented for leachate collection and treatment or gas migration monitoring and interception. These details should be provided following further analysis.

SPECIFIC COMMENTS

1. Sheet 2. No scale is given in this drawing. It is recommended that horizontal and vertical control be given for property pins. This sheet depicts test pit 5 with water; Plate 2 in the text notes it to be dry. Similarly, this sheet shows test pit 17 as dry; Plate 2 shows water. See specific comments 6 and 12 on the hydrogeologic analysis report.

2. Sheet 3. The natural gas pipeline noted probably has an easement. The gas line intersection coordinates with the property line should be noted. No perimeter fencing is noted on the drawing. An easement/title to the access road should be analyzed. The sheet shows a gate relocation and new access road on abutting private property. Also, access road construction details should be given. The sheet shows two surface water detention ponds. One reflects a dam height of approximately 20 to 25 feet and the other dam approximately 30 to 35 feet high. A site water balance should be completed. Surface water runoff calculations and pond sizing should also be completed and presented for review.
3. Sheet 5. This sheet indicates shallow ground water interception and conveyance to private property east of the landfill area. Surface drainage will also be conveyed across private property to the east. Ground and surface water should be collected and routed to the west on district property. No easterly surface water detention is shown. The final contours proposed result in slopes of ± 10 percent for the existing landfill area. Erosion and slope stability analyses should be performed to determine the acceptability of these slopes. At the proposed ground water subdrain and gas line intersection, the contours indicate that the gas line is spanning the ditch. The contours should be revised. Similarly, the subdrain and gravel pit access road intersection contours should be changed. The current drawing assumes that the access road will be retained.
4. Sheet 6. This sheet shows the subdrain and gas line intersection to include a 100-foot corrugated metal pipe (CMP) and dike to retain the gas line. The saturated condition of these soils may make this dike unstable. The gas line company probably has an easement with which this plan must be consistent. The district, therefore, must have permission to construct as planned. The sheet indicates that the access road has been abandoned. This should be confirmed by those using the road. The subdrain will, as noted earlier, convey ground water (and surface water) to private property on the east. It is recommended that the subdrain grade be revised and all surface and ground water drainage be confined to district property. The subdrain, as depicted, varies in elevation from $\pm 2,587$ feet to $\pm 2,575$ feet. Ground water below these elevations will continue to migrate north through the existing landfill. This ground water should be intercepted or leachate collection provided below the existing landfill. Slope stake limits for the subdrain should be included on this sheet. The subdrain excavation will be in water and trench stability issues should be addressed.
5. Sheet 15. The existing ground water level is reportedly at an elevation of $\pm 2,590$ feet. The subdrain on Sheet 6 is at an elevation of $\pm 2,587$ feet to $\pm 2,575$ feet. The existing landfill contains trash below elevation $\pm 2,575$ feet, which will continue to be saturated with the subdrain proposed. A method to prevent continued saturation of the trash should be presented.

CONCLUSIONS:

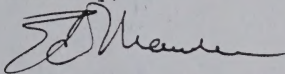
The weak characterization of bedrock and shallow groundwater quality and flow, combined with the lack of a design for a leachate collection system, is a major concern. Placement of all downgradient and at least one upgradient monitoring wells within the required proximity of the waste area is a necessary addition to your plan.

The recommended method for diverting groundwater from the seeps away from the waste area, albeit cost effective, does not appear to be the most environmentally effective.

Your report represents a plan to substantially change your existing licensed landfill area by laterally expanding to the north. Substantial change to an existing facility may be subject to application review fees if Proposed Rule VIII, provided for by Section 75-10-115, MCA, is adopted. The application review fee under consideration by the Department, is currently \$7,500.00 for an Intermediate Class Two Landfill. This proposed fee reflects the costs involved with the application review.

We realize that the process of improving the environment for your landfill operations has not been an easy one. The comments included in this document are meant to help, not criticize your efforts. We are here to help. If we can be of any assistance, please do not hesitate to call.

Sincerely,



Edward A. Thamke
Solid Waste Management

cc: Barry Damschen, P.E., Damschen & Associates, Inc., P.O. Box 4817,
Helena, MT. 59604

SECRET

The main objective of the study was to determine the effect of the proposed changes on the economy. The study was conducted by the Department of the Interior, Bureau of Land Management, and the Bureau of Reclamation. The study was conducted in 1974 and 1975. The study was conducted in the following areas: (1) the effect of the proposed changes on the economy, (2) the effect of the proposed changes on the environment, and (3) the effect of the proposed changes on the social and cultural resources.

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